

What is claimed is:

1 1. A method for preventing formation of photoresist
2 scum, comprising the steps of:

3 providing a substrate on which a dielectric layer is
4 formed;

5 forming a non-nitrogen anti-reflective layer on the
6 dielectric layer; and

7 forming a photoresist pattern layer on the non-nitrogen
8 anti-reflective layer, wherein during the
9 formation of the photoresist pattern layer, the
10 non-nitrogen anti-reflective layer does not react
11 with the photoresist pattern layer, thus not
12 forming photoresist scum.

1 2. The method as claimed in claim 1, further
2 comprising forming an etching stop layer containing no
3 nitrogen between the substrate and the dielectric layer.

1 3. The method as claimed in claim 1, wherein the non-
2 nitrogen anti-reflective layer is a silicon-rich oxide
3 layer.

1 4. The method as claimed in claim 1, wherein the non-
2 nitrogen anti-reflective layer is a hydrocarbon-containing
3 silicon-rich oxide layer.

1 5. A method for formation of photoresist scum,
2 comprising the steps of:

3 providing a substrate on which a dielectric layer is
4 formed;
5 forming a non-nitrogen anti-reflective layer on the
6 dielectric layer;
7 forming a first photoresist pattern layer on the non-
8 nitrogen anti-reflective layer, wherein during
9 the formation of the first photoresist pattern
10 layer, the non-nitrogen anti-reflective layer
11 does not react with the first photoresist pattern
12 layer, thus not forming photoresist scum;
13 etching the non-nitrogen anti-reflective layer and the
14 dielectric layer using the first photoresist
15 pattern layer as a mask to form a via hole;
16 removing the first photoresist pattern layer to expose
17 the non-nitrogen anti-reflective layer surface;
18 and
19 forming a second photoresist pattern layer on the non-
20 nitrogen anti-reflective layer, wherein during
21 the formation of the second photoresist pattern
22 layer, the non-nitrogen anti-reflective layer
23 does not react with the second photoresist
24 pattern layer, thus not forming photoresist scum.

1 6. The method as claimed in claim 5, further
2 comprising forming an etching stop layer between the
3 substrate and the dielectric layer.

1 7. The method as claimed in claim 6, further
2 comprising forming a barrier layer between the etching stop
3 layer and the dielectric layer to block a dopant in the
4 etching stop layer from diffusing into the dielectric layer.

1 8. The method as claimed in claim 7, wherein the
2 barrier layer is a silicon-rich oxide layer.

1 9. The method as claimed in claim 7, wherein the
2 barrier layer is a hydrocarbon-containing silicon-rich oxide
3 layer.

1 10. The method as claimed in claim 7, wherein the
2 barrier layer has a thickness of 50 to 1000 Å.

1 11. The method as claimed in claim 7, wherein the
2 dopant is nitrogen.

1 12. The method as claimed in claim 5, wherein the non-
2 nitrogen anti-reflective layer is a silicon-rich oxide
3 layer.

1 13. The method as claimed in claim 5, wherein the non-
2 nitrogen anti-reflective layer is a hydrocarbon-containing
3 silicon-rich oxide layer.

1 14. A method, comprising the steps of:
2 providing a substrate on which an etching stop layer, a
3 dielectric layer, a first barrier layer, and an
4 anti-reflective layer are formed, wherein the
5 first barrier layer blocks a first dopant in the
6 anti-reflective layer from diffusing into the
7 dielectric layer;
8 etching the anti-reflective layer and the dielectric
9 layer to form a via hole;
10 forming a protective plug in the via hole;

11 forming a photoresist pattern layer on the anti-
12 reflective layer, wherein the first barrier layer
13 blocks the first dopant in order to prevent
14 forming photoresist scum in the via hole; and
15 etching the anti-reflective layer, the first barrier
16 layer and the dielectric layer using the
17 photoresist pattern layer and the protective plug
18 as a mask to form a trench above the via hole,
19 thus forming a dual damascene structure.

1 15. The method as claimed in claim 14, wherein the
2 first barrier layer is a silicon-rich oxide layer.

1 16. The method as claimed in claim 14, wherein the
2 first barrier layer is a hydrocarbon-containing silicon-rich
3 oxide layer.

1 17. The method as claimed in claim 14, wherein the
2 first barrier layer has a thickness of 50 to 1000 Å.

1 18. The method as claimed in claim 14, wherein the
2 first dopant is nitrogen.

1 19. The method as claimed in claim 14, further forming
2 a second barrier layer between the etching stop layer and
3 the dielectric layer, wherein the second barrier layer
4 blocks a second dopant in the etching stop layer from
5 diffusing into the dielectric layer.

1 20. The method as claimed in claim 19, wherein the
2 second barrier layer is a silicon-rich oxide layer.

1 21. The method as claimed in claim 19, wherein the
2 second barrier layer a hydrocarbon-containing silicon-rich
3 oxide layer.

1 22. The method as claimed in claim 19, wherein the
2 second barrier layer has a thickness of 50 to 1000 Å.

1 23. The method as claimed in claim 19, wherein the
2 second dopant is nitrogen.

1 24. The method as claimed in claim 14, wherein the
2 stop layer is a silicon-rich oxide layer.

1 25. The method as claimed in claim 14, wherein the
2 stop layer is a hydrocarbon-containing silicon-rich oxide
3 layer.

1 26. The method as claimed in claim 14, wherein the
2 protective plug is i-line photoresist.

1 27. The method as claimed in claim 14, further forming
2 a third barrier layer on the anti-reflective layer.

1 28. The method as claimed in claim 27, wherein the
2 third barrier layer is a silicon-rich oxide layer.

1 29. The method as claimed in claim 27, wherein the
2 third barrier layer is a hydrocarbon-containing silicon-rich
3 oxide layer.

1 30. The method as claimed in claim 27, wherein the
2 third barrier layer has a thickness of 50 to 1000 Å.

1 31. A method of preventing formation photoresist scum
2 for dual damascene process, comprising the steps of:

3 providing a substrate on which an etching stop layer, a
4 first barrier layer, a dielectric layer, a second
5 barrier layer, an anti-reflective layer, and a
6 third barrier layer are formed;

7 etching the third barrier layer, the anti-reflective
8 layer, the second barrier layer, the dielectric
9 layer, and the first barrier layer to form a via
10 hole;

11 forming a protective plug in the via hole;

12 forming a photoresist pattern layer over the anti-
13 reflective layer, wherein the second barrier
14 layer and the third barrier layers block a first
15 dopant in the anti-reflective layer from
16 diffusing into the dielectric layer and the first
17 barrier layer blocks a second dopant in the
18 etching stop layer from diffusing into the same,
19 in order to prevent forming photoresist scum in
20 the via hole; and

21 etching the third barrier layer, the anti-reflective
22 layer, the second barrier layer and the
23 dielectric layer using the photoresist pattern
24 layer and the protective plug as a mask to form a
25 trench above the via hole, thus forming a dual
26 damascene structure.

1 32. The method as claimed in claim 31, wherein the
2 first barrier layer is a silicon-rich oxide layer.

1 33. The method as claimed in claim 31, wherein the
2 first barrier layer is a hydrocarbon-containing silicon-rich
3 oxide layer.

1 34. The method as claimed in claim 31, wherein the
2 first barrier layer has a thickness of 50 to 1000 Å.

1 35. The method as claimed in claim 31, wherein the
2 second barrier layer is a silicon-rich oxide layer.

1 36. The method as claimed in claim 31, wherein the
2 second barrier layer is a hydrocarbon-containing silicon-
3 rich oxide layer.

1 37. The method as claimed in claim 31, wherein the
2 second barrier layer has a thickness of 50 to 1000 Å.

1 38. The method as claimed in claim 31, wherein the
2 third barrier layer is a silicon-rich oxide layer.

1 39. The method as claimed in claim 31, wherein the
2 third barrier layer is a hydrocarbon-containing silicon-rich
3 oxide layer.

1 40. The method as claimed in claim 31, wherein the
2 third barrier layer has a thickness of 50 to 1000 Å.

1 41. The method as claimed in claim 31, wherein the
2 first dopant is nitrogen.

1 42. The method as claimed in claim 31, wherein the
2 second dopant is nitrogen.

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- 1 43. The method as claimed in claim 31, wherein the
- 2 protective plug is i-line photoresist.